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THE ENDOCARP OF THE SOUTHERN AFRICAN MENISPERMACEAE

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ABSTRACT

The shape of the fruit and the characteristics of the superficial sculpturing of the endocarp of the 13 species are described and illustrated. The taxonomic significance of these characteristics is pointed out and a key is provided to distinguish between fruit of the different genera as well as between the species of *Tinospora*.

UITTREKSEL

DIE ENDOKARP VAN DIE SUIDER-AFRIKAANSE MENISPERMACEAE

Die vorm van die endokarp en die aard van die oppervlakpatrone daarop van die 13 spesies word bespreek en geïllustreer. Die taksonomiese belangrikheid van hierdie kenmerke word aangetoon en 'n sleutel word voorsien om tussen die vrugte van die verskillende genusse te onderskei asook tussen die *Tinospora*-spesies.

INTRODUCTION

"Menisperma" refers to the peculiar hippocrepiform (horseshoe-shaped) fruit and/or seeds found in the majority of the species of this family.

The plants are dioecious with the flowers mostly inconspicuous. The ovary consists of 1–12 free carpels. The style is very short or absent and the stigma lobed or cleft. Initially, each carpel is erect, containing the ovule with basal placentation, but due to unequal growth during development, it gradually bends inwards to attain its characteristic shape.

The name *Menispermum* was first used by Tournefort, accepted by Linnaeus in his *Species plantarum* (1753) and published by A. L. de Jussieu in his *Genera plantarum* (1789).

The diagnostic shape of the fruit enabled Chesters (1957), to allocate fossilised fruit from the Miocene of Rusinga Island, Lake Victoria, to the extant genera *Cissampelos, Stephania* and *Triclisia*.

Miers (1871), Diels (1910) and Troupin (1962) paid some attention to endocarp characteristics. Although illustrations of certain species were provided, the taxonomic importance of the finer detail was not fully realised and exploited. Forman (1956, 1974), however, being aware of the taxonomic value of these endocarp patterns, used them in descriptions and keys of the Malaysian species of *Stephania* and in the description of *Cocculus*.

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MATERIAL AND METHODS

Seven genera, thirteen species and two varieties occur in Southern Africa. Five samples of fruit of each taxon, collected where possible from different localities, were examined.

Fresh and dried fruit were boiled in water, transferred to a 5 % cellulase solution in distilled water and left for 12–30 h at 30 °C to dissolve the outer layers of the pericarp. The endocarp was finally cleaned with a stiff nylon brush.

Because of the relatively large size of some fruits, e.g. that of *Albertisia delagoensis* (which may be up to 18 mm in diameter), it was impossible to obtain comparable scanning electron micrographs of all the objects. A Zeiss Tessovar was therefore used to obtain photomacrographs.

RESULTS

The endocarp is bony, with the exception of one genus in which it is parchment-like. The shape is more or less ellipsoidal in a few species and horseshoe-shaped in the remainder of the cases.

The condyle (Fig. 1C), is absent in one genus and in the others varies from linear to narrowly obovate, obovate or forming an enclosed globular cavity within

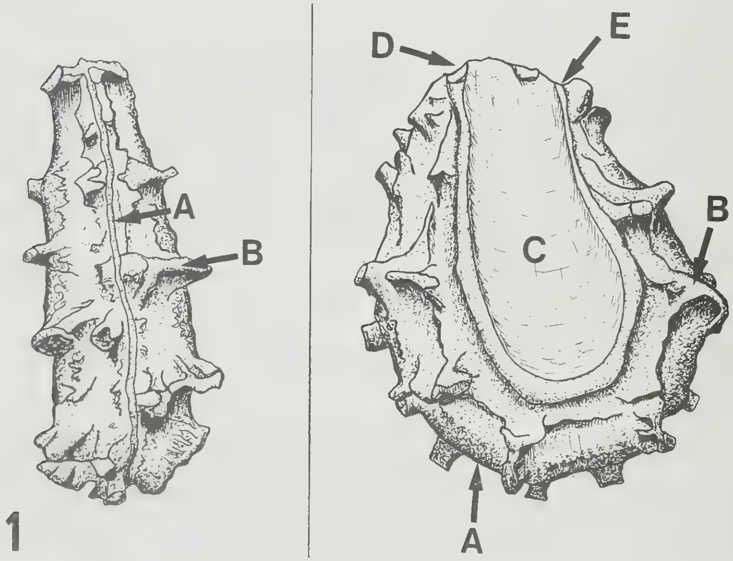
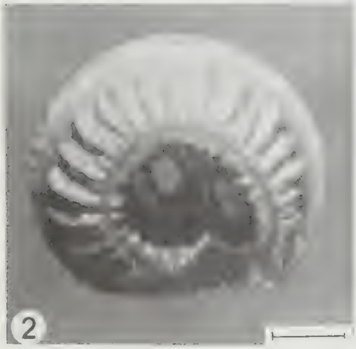


FIG. 1.
Two different views, showing the shape and morphology of the endocarp of *Stephania abyssinica* var. *abyssinica* with dorsal ridge (A); radial ridge (B); condyle (C); position of stigma (D) and attachment of funiculus (E).

the endocarp. Perforation of the septum of the condyle is conspicuous, inconspicuous or absent. The surface of the endocarp is fairly smooth or wrinkled, or exhibits a definite sculpturing in the form of ribs, ridges, knobs or scales.

KEY TO THE GENERA BASED ON THE STRUCTURE OF THE ENDOCARP

- Endocarp horseshoe-shaped, condyle linear, narrowly obovate, obovate or more or less circular:
  - Condyle more or less circular with the perforation usually conspicuous . . . 1. **Cocculus**
  - Condyle linear, narrowly obovate or obovate; perforation very small or absent:
    - Condyle narrow or linear, laterally somewhat convex; surface of endocarp more or less smooth without prominent knobs or tubercles . . . . 2. **Tiliacora**
    - Condyle narrowly obovate or obovate; laterally somewhat concave; surface of endocarp usually with prominent ridges, knobs, scales or tubercles:
      - Condyle obovate; septum smooth, unperforated; dorsal ridge conspicuous . . . . 5. **Stephania**
      - Condyle narrowly obovate; septum somewhat rough, often perforated; dorsal ridge inconspicuous or absent:
        - Radial ridges or plates prominent and more or less perpendicular to the surface of the endocarp, or flattened and wrinkled with the lateral girdle, adjacent to the condyle fairly smooth . . . . 7. **Cissampelos**
        - Radial ridges either flowing into one another, or scale-like and pointing towards the condyle, or sometimes warty; lateral girdles adjacent to condyle fairly rough in texture . . . . 6. **Antizoma**
- Endocarp not horseshoe-shaped; condyle absent or in the form of an enclosed globular cavity within the endocarp:
  - Condyle absent; endocarp parchment-like, wrinkled . . . . 4. **Albertisia**
  - Condyle in the form of an enclosed globular cavity within the endocarp; endocarp bony . . . . 3. **Tinospora**



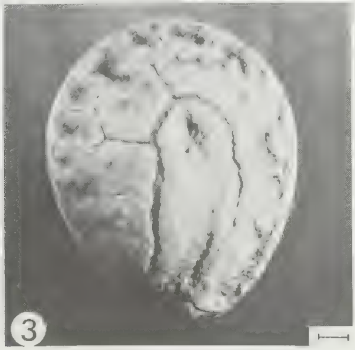


FIG. 2.
Cocculus hirsutus. Lateral view with perforation (A) conspicuous.

FIG. 3.
Tiliacora funifera. Lateral view.

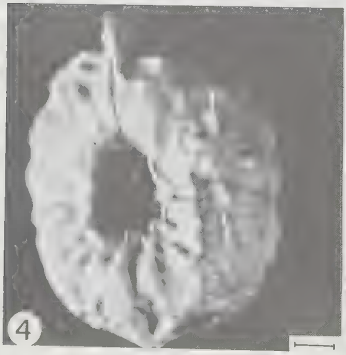
Description of the Species

1. *Cocculus hirsutus* (L.) Diels (Fig. 2)
   Endocarp bony, horseshoe-shaped; condyle more or less circular; septum usually perforated; dorsal ridge sharp, prominent; lateral ridges often inconspicuous and separated from the dorsal ridge by a girdle or irregular ridges; edge of condyle involute, composed of many radial ridges.
2. *Tiliacora funifera* (Miers) Oliv. (Fig. 3)
   Endocarp bony, horseshoe-shaped, laterally somewhat convex, condyle narrow or linear; dorsal ridge inconspicuous with many short radially-arranged shallow grooves; lateral surface with a shallow U-shaped furrow bordering on the condyle.
3. *Tinospora* Miers emend Troupin
   Endocarp bony, ovoidal or more or less ellipsoidal with the condyle as an enclosed globular cavity within the endocarp; surface fairly smooth or with a few distal and proximal knobs.

Key to the Species of *Tinospora*

Condyle elliptic:
  Endocarp ovoidal without any distal or proximal knobs .... 3.1 **T. fragosa**
  Endocarp more or less ellipsoidal; distal and proximal knobs conspicuous .... 3.3 **T. caffra**
Condyle with four prominent lobes .... 3.2 **T. tenera**

3.1 *Tinospora fragosa* (Verdoorn) Verdoorn et Troupin (Figs 4, 5)
Endocarp bony, ovoidal without any distinct knobs or tubercles; condyle elliptic.



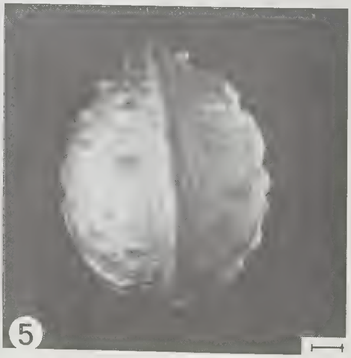


Fig. 4.
Tinospora fragosa. Ventral view.

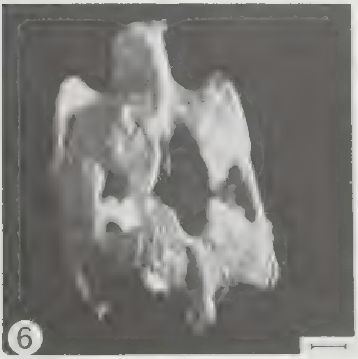
Fig. 5.
T. fragosa. Dorsal view.

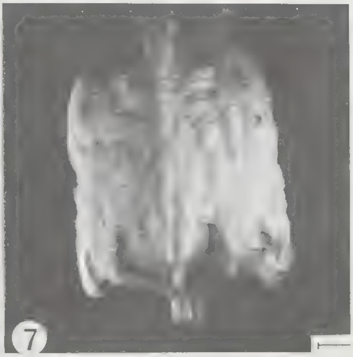
3.2 *Tinospora tenera* Miers (Figs 6, 7)

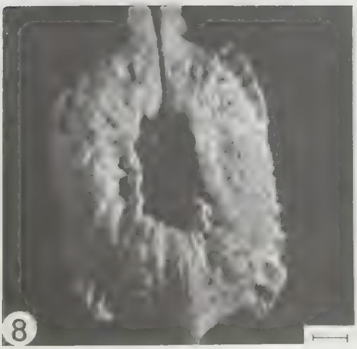
Endocarp bony, more or less ellipsoidal with base somewhat flattened; distal and proximal knobs conspicuous; condyle with four prominent lobes.

3.3 *Tinospora caffra* (Miers) Troupin (Figs 8, 9)

Endocarp bony, more or less ellipsoidal with base somewhat flattened; distal and proximal knobs conspicuous; outline of condyle elliptic.







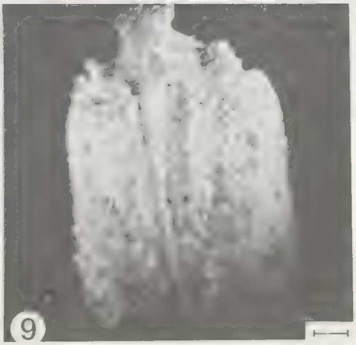


FIG. 6.
T. tenera. Ventral view.

FIG. 7.
T. tenera. Dorsal view.

Each scale division represents one millimetre.

FIG. 8.
Tinospora caffra. Ventral view.

FIG. 9.
T. caffra. Dorsal view.

4. *Albertisia delagoensis* (N.E.Br.) Forman (Fig. 10)
   Endocarp parchment-like, wrinkled without any definite surface sculpturing; not horseshoe-shaped, condyle absent.
5. *Stephania abyssinica* (Dill. et Rich.) Walp. (Fig. 11)
   Endocarp bony; horseshoe-shaped; laterally concave; condyle obovate; septum smooth, imperforate; one dorsal and two lateral ridges very conspicuous and interconnected by radially arranged ridges; the latter sometimes with sharp points.
   The endocarps of the two varieties e.g. *S. abyssinica* (Dill. et Rich.) Walp. var. *abyssinica* and *S. abyssinica* (Dill. et Rich.) Walp. var. *tomentella* (Oliv.) Diels could not be distinguished from one another.
6. *Antizoma* Miers (Figs 12, 13)
   Endocarp bony; horseshoe-shaped; laterally concave; condyle narrowly obovate; septum somewhat rough, often perforated; dorsal ridge absent and replaced by a fissure or shallow furrow bordered on both sides by two or three lateral girdles of radial ridges; radial ridges flattened or sometimes warty radiating from the condyle, lateral girdle adjacent to condyle fairly rough.
   The great similarity in the structure of the endocarps of this genus makes the construction of a key to distinguish between the fruit of the two species, viz. *A. angustifolia* (Burch.) Miers ex Harv. and *A. miersiana* Harv., impossible.
7. *Cissampelos* L. emend Miers (Figs 14, 15, 16, 17)
   Endocarp bony; horseshoe-shaped; laterally concave, condyle narrowly obovate; septum somewhat rough, often perforated; dorsal ridge often inconspicuous or absent and replaced by a fissure or shallow furrow, bordered on both sides by two or three lateral girdles, the latter either composed of radial ridges with prominent plates or tubercles arranged perpendicular to the surface, or with a wrinkled surface, with the lateral girdle, adjacent to the condyle fairly smooth.
   Four species, e.g. *C. capensis* L.f., *C. hirta* Klotzsch, *C. mucronata* A. Rich. and *C. torulosa* E. Mey. ex Harv. occur in Southern Africa, but again, due to the great similarity in the structure of their endocarps, the compilation of a key to distinguish between them has been found impossible.

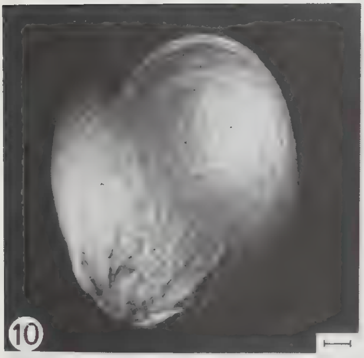
CONCLUSIONS

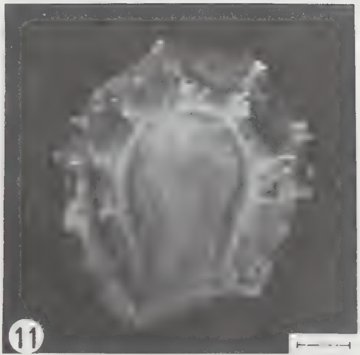
The features of the endocarp of the Southern African Menispermaceae are so characteristic that they can usually be used as an additional aid to identification.

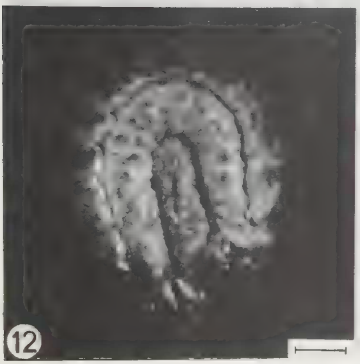
The similarity in the structure of the endocarp suggests a close relationship between *Antizoma* and *Cissampelos*.

Three endocarp types have been recognised, e.g.:

(i) endocarp ellipsoidal with no condyle;







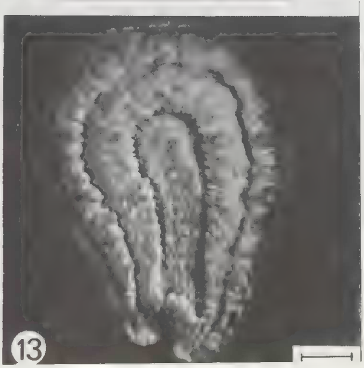


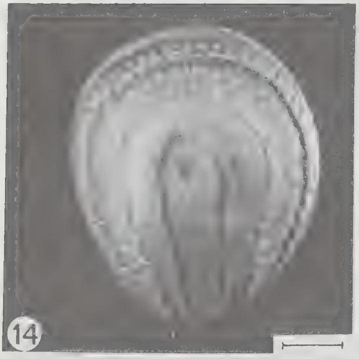
FIG. 10.
Albertisia delagoensis. Lateral view.

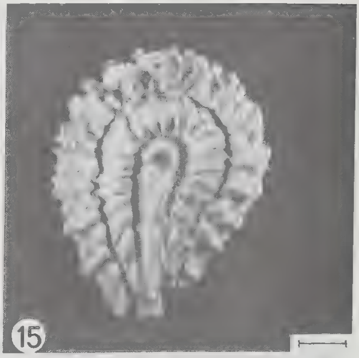
FIG. 11.
Stephania abyssinica. Lateral view.

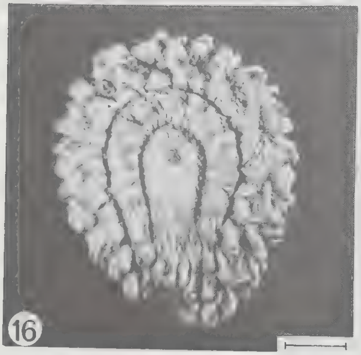
FIG. 12.
Antizoma angustifolia. Lateral view.

FIG. 13.
A. miersiana. Lateral view.

Each scale division represents one millimetre.







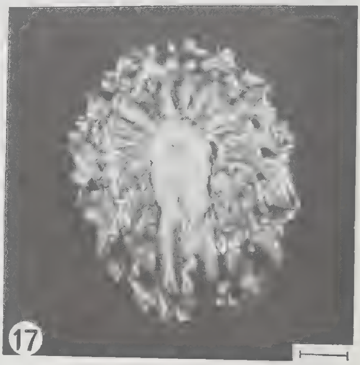


FIG. 14.
Cissampelos capensis. Lateral view.

FIG. 15.
C. hirta. Lateral view.

FIG. 16.
C. mucronata. Lateral view.

FIG. 17.
C. torulosa. Lateral view.

Each scale division represents one millimetre.

(ii) endocarp ellipsoidal with a flattened base and the condyle occurring as an enclosed globular cavity within the endocarp; and

(iii) endocarp horseshoe-shaped with the condyle linear, obovate or narrowly obovate.

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